



GEORGE E. BROWN, JR. SALINITY LABORATORY



BIENNIAL REPORT 1999-2000

Biennial Report 1999-2000

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INTRODUCTION

We exit one millennium and begin another with a new name and new challenges. On January 21, 2000, the U.S. Salinity Laboratory was renamed in honor of the late congressman George E. Brown Jr. who's legislative efforts to advance agricultural technology and international cooperation led to the construction and dedication of the new USDA-ARS Riverside facility. Our Laboratory has long been known for its cutting edge technology and joint science projects with other countries. Brown saw a need to improve the working conditions of agricultural scientists and fought for a decade to obtain funding to build a modern, state-of-the-art facility to replace the aging lab that had operated near Mount Rubidoux for 58 years. The new laboratory opened in 1995 and was renamed and dedicated to Congressman Brown after his death in 1999. The George E. Brown Jr. Salinity Laboratory continues to serve the research needs of U.S. agriculture through its relevant, productive and creative scientific research programs.

As water quality and quantity becomes limited globally, problems associated with salinity have increased dramatically. Since agriculture is by far the dominant user of most of our water supply, there is growing interest in increasing the efficiency of water management through reuse of agricultural drainage water and other water currently considered as municipal or industrial waste water. There is an increased demand for salinity assessment criteria and measurement methods and tools; and there is a greater need to make more reliable and useful decision support models available to growers, water and drainage districts, and state and federal decision makers. Public concern for environmental and human health and safety have resulted in demands to reduce the impact that agricultural practices have on loading groundwater and surface water with salts, pesticides, nitrates, and other potentially toxic ions. Human health and safety is an emergent research concern associated with water reuse. It will be up to our staff to address these important issues and to contribute, through research and technology transfer, to solutions.

Last year the Laboratory responded to the changing needs of the agriculture through the addition of a new research group. The Food Safety Research Group is focused on preventing contamination of surface and ground waters from microbiological and chemical contaminants from concentrated animal feeding operations. The new research project will be led by new hires Mark Ibekwe, Microbiologist and Scott Bradford, Soil Scientist. Pamela Watt, Microbiological technician was also hired to assist the group. Xuan Liu, Biological Science Technician also began work during the year and will be assisting Clyde Wilson in the Plant Science Unit. The Soil Physics and Pesticide Research Unit hired one postdoctoral scientist, Robert Dungan to study how soil microorganisms help degrade fumigants.

In 1999, Frank Dalton retired after over 20 years of Federal Service. Dr. Dalton has been a pioneer in developing a dynamic salinity stress index that characterizes the effects of variable soil and climate factors on plant response. This work is truly unique and creative and will lead to future understanding in plant salinity stress research.

Other retirements include Robert LeMert from the Soil & Water Chemistry group after 44 years of Federal Service and Gladys Greer, Administrative Officer, who retired from the Location Office after 58 years of Federal Service. Other significant highlights include National and Area Awards.

As usual, several Salinity Laboratory scientists were recognized for outstanding achievement during the year. Sabine Goldberg, Soil Scientist, received the Soil Science Society America Fellow Award in 1999 from USDA for her research on adsorption chemistry of nutrient and trace element anions in soils and the effect of variably-charged surfaces on soil structure. Dennis Corwin, Soil Scientist, received the Stanford University's Cox Professor Award in 1999 in recognition of the pioneering work and continued accomplishments for the application of Geographic Information Systems and other advanced information technologies to the assessment of non-point source pollutants in the vadose zone. Martinus Th. van Genuchten, Supervisory Soil Scientist/Research Leader, received the 1999 Don and Betty Kirkham Soil Physics Award for recognition of outstanding contributions in the area of soil physics. Many others received local awards for their excellent efforts in research, research support, and activities associated with outreach, safety and civil rights. Our research effort during the last two years, led by our 14 research scientists, yielded over 100 publications excluding abstracts.

In the coming years we look forward to new challenges, great scientific accomplishment, and continued improvement of our scientific effort and productivity.

Michael C. Shannon
Director

GEORGE E. BROWN, JR. SALINITY LABORATORY STAFF

<u>NAME</u>	<u>TITLE</u>
Alves, Bill	Computer Specialist
Austin, Richard	Electronics Technician
Bradford, Scott	Soil Scientist
Carroll, Peggy	Accounting Technician
Cliath, Mark	Chemist
Collier, William	Administrative Officer
Cook, Roberta	Secretary (Physics & Pesticide)
Corwin, Dennis	Soil Scientist
Dalton, Frank	Soil Scientist
Donovan, Terry	Agronomist
Draper, John	Biological Technician (Soils)
Dungan, Robert	Postdoc Scientist
Ernst, Fred	Soil Scientist
Fargerlund, JoAn	Physical Science Technician
Faust, Steve	Machinist
Forster, Harry	Physical Science Technician
Gan, Jay	Associate Researcher
Goldberg, Sabine	Soil Scientist
Greer, Gladys	Administrative Officer (retired 01/00)
Grieve, Catherine	Plant Physiologist
Hopper, Jennifer	Physical Science Technician
Huber, Mike	Engineering Technician
Ibekwe, M.	Microbiologist
Jobes, Jack	Agricultural Science Research Technician (Soils)
Layfield, Donald	Analytical Chemist
Lebron, Inma	Soil Scientist
LeMert, RoseAnn	Physical Science Technician
LeMert, Robert	Senior Farm Machinery Mechanic
Leij, Feike	Soil Scientist
Leung, Suzanne	Postdoc Scientist
Lesch, Scott	Senior Statistician
Liu, Xuan	Plant Physiologist
Luther, Sondra	Secretary (Plant)
Manning, Bruce	Soil Scientist

NAMETITLE

Moore, JoAnn	Purchasing Agent
Mohanty, Binayak	Assistant Researcher
Nash, Phyllis	Statistician
Orlauski, Janice	Office Assistant
Padgett, Karen	Secretary (Director)
Papiernik, Sharon	Soil Scientist
Rose Coons, JoAnne	Secretary (Chemistry)
Poss, Jim	Soil Scientist
Rhoades, James	Soil Scientist
Russell, Walt	Mathematician
Schaap, Marcel	Soil Physicist
Shannon, Mike	Director/Supvy. Research Geneticist
Shouse, Pete	Soil Scientist
Skaggs, Todd	Soil Scientist
Simunek, Jirka	Hydrologist
Suarez, Donald	Research Leader/Supvy. Geologist
Taylor, Chris	Chemist
van Genuchten, M. Th.	Research Leader/Supvy. Soil Scientist
Vaughan, Peter	Research Hydrologist
Vishteh, Nahid	Biological Science Technician
Wang, Dong	Soil Scientist
Watt, Pam	Microbiologist
Wilson, Clyde	Plant Physiologist
Wood, Jim	Soil Scientist
Yates, Scott	Soil Scientist
Zeng, Linghe	Research Geneticist
Zhang, Ping	Staff Research Associate

1999-2000 VISITING SCIENTISTS ON STAFF

(Argentina)

Maria Correa

(Belgium)

Fariborz Abbasi

Diederik Jacques

(China)

Weiiping Liu

Qi-Quan Wang

Chi-Chuang Wang

Shi-Kui Xue

Chengyi Zhao

Jianting Zhu

(Denmark)

Christen Borgesen

(Egypt)

Mohamed Elsayed Galal

Akmal Karimov

Ahmed H. Khater

Mohamed Eldayed Shahab

Ahmed Ezzat Abdel Wahab

Basyouni Abdel Razak Zayed

(Hungary)

Attila Nemes

Tibor Toth

(India)

Lalit Arya

(Italy)

Paolo Castiglione

(Japan)

Takeshi Ishizaki

Qingli Ma

Naomasa Nishimura

Tomoko Yoshida

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Products of Propargyl Bromide Degradation in Soil
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Mechanism of Degradation of Methyl Bromide and Propargyl Bromide in Soil
S.K. Papiernik, J. Gan and S.R. Yates

Permeability of Plastic Films to Fumigant Vapors
S.K. Papiernik and S.R. Yates

Herbicide-Salinity Interaction Effects on Phytotoxicity
S.K. Papiernik, C.M. Grieve, J. Gan, F.F. Ernst and S.R. Yates

Development and Use of a Hierarchical Set of Neural Network
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B. Imam, S. Sorooshian, T. Mayr, M.G. Schaap, H. Wosten and B. Scholes

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P.D. Meyer, G.W. Gee, M.L. Rockhold and M.G. Schaap

Estimation of the Soil Hydraulic Properties
M.G. Schaap, F.J. Leij and M. Th. van Genuchten

Improved Prediction of Unsaturated Hydraulic Conductivity With the
Mualem-van Genuchten Model
M.G. Schaap and F.J. Leij

Parameter Correlation Structures of Hydraulic Functions
M.G. Schaap and F.J. Leij

Evaluation of Existing and Site-Specific Pedotransfer Functions to
Predict Hydraulic Properties for Hanford Site Sediments
M.G. Schaap and P.D. Meyer

Application of TDR and Frequency Analysis to Study the Calcic-Sodic
Status of a Soil
M.G. Schaap, I. Lebron and D.L. Suarez

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R. Zhang, P.J. Shouse and S.R. Yates

Vacuum Method for Field Installation of Pipes and Casings
in Sandy Soils
L. Ulery, S. Stewart, D.A. Reid and P.J. Shouse

Spatial Dependence of Soil Water Retention and Thermal
Properties of a Sandy Loam Soil
P.J. Shouse, B.P. Mohanty and T.H. Skaggs

Nonlinear Dynamics of Soil Moisture and Temperature
at Different Scales
P.J. Shouse, T.H. Skaggs and B.P. Mohanty

Application of Moment Analysis for Estimating Transport and
Reaction Parameters From Breakthrough Curves
B.S. Das, I.W. Wraith, H.W. Langner, P.J. Shouse and G.J. Kluitenberg

Inverse Optimization, Calibration and Validation of Simulation
Models at the Field Scale
J. Šimůnek and J.A. de Vos

Horizontal Infiltration Revisited Using Parameter Estimation
J. Šimůnek, J.W. Hopmans, D.R. Nielsen and M. Th. van Genuchten

Estimating Hysteresis in the Soil Water Retention Function
From Cone Permeameter Experiments
J. Šimůnek, R. Kodesova, M.M. Gribb and M. Th. van Genuchten

Using the Hydrus-1D and Hydrus-2D Codes for Estimating
Unsaturated Soil Solute Transport Parameters
J. Šimůnek, M. Th. van Genuchten and M. Sejna

The Hydrus-2D Software Package For Simulating Two-Dimensional Movement of Water, Heat, and Multiple Solutes in Variably- Saturated Media, Version 2.0	J. Šimůnek, M. Sejna and M. Th. van Genuchten
Inverse Analysis of Transient Variably-Saturated Water Flow and Solute Transport Column Studies	J. Šimůnek, J. Vanderborght and M. Th. van Genuchten
Estimating Unsaturated Soil Hydraulic Properties From Laboratory Tension Disc Infiltrometer Experiments	J. Šimůnek, O. Wendroth and M. Th. van Genuchten
Soil Hydraulic Properties From Laboratory Evaporation Experiments by Parameter Estimation	J. Šimůnek, O. Wendroth and M. Th. van Genuchten
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Review of Inverse Estimation of Soil Hydraulic Properties	J. W. Hopmans and J. Šimůnek
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The Disc Computer Software for Analyzing Tension Disc Infiltrometer Data By Parameter Estimation, Version 1.0	J. Šimůnek and M. Th. van Genuchten
Inverse Estimation of Unsaturated Soil Hydraulic and Solute Transport Parameters Using the Hydrus-1D Code	J. Šimůnek and M. Th. van Genuchten
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Infiltration of Water Into Soil With Cracks	V. Novak, J. Šimůnek and M. Th. van Genuchten
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M. Th. van Genuchten

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M. Th. van Genuchten and E.A. Sudicky

SUFI: An Inverse Program for Conditional Parameter Estimation
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L.M. Arya, T.S. Dierolf, A. Sofyan, P. Widjaja-Adhi and M. Th. van Genuchten

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U. Fischer, M.A. Celia, H. Fluhler and M. Th. van Genuchten

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M. Th. van Genuchten

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T. Vogel, M. Th. van Genuchten and M. Cislerova	
Dynamics of Water and Solute Movement in Aggregated Soils	
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Atmospheric Volatilization of Methyl Bromide, 1,3-Dichloropropene, and Propargyl Bromide Through Two Plastic Films: Transfer Coefficient and Temperature Effect	
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Automated Sequential Sampler For Collection of Highly Volatile Atmospheric Contaminants	
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Transformation and Detoxification of Halogenated Fumigants by Ammonium Thiosulfate	
D. Wang, J. Gan, S.K. Papiernik and S.R. Yates	
Transformation and Detoxification of Soil Fumigants by Ammonium Thiosulfate	
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Methods For Removing and Decomposing Methyl Bromide
From Fumigation Gases
S.R. Yates and J. Gan

Modeling the Fate and Transport of Volatile Pesticides
S.R. Yates, D. Wang, S. Papiernik and J. Gan

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S.R. Yates and A.W. Warrick

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F. van den Berg, G.R. Kubiak, W.G. Benjey, M.S. Majewski,
S.R. Yates, G.L. Reeves, H.H. Smellt and A.M.A. van der Linden

Reducing Fumigant Emissions After Soil Application
S.R. Yates, J. Gan, S.K. Papiernik, R. Dungan and D. Wang

Analytical Solutions For The Transport of Volatile Organic
Chemicals in Unsaturated Layered Systems
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S.R. Yates, S.K. Papiernik, Q.L. Ma and J. Gan

Controlling Agricultural Emissions of Methyl Bromide
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Theory And Laboratory Study of a Tall Passive Chamber For
Measuring Gas Fluxes At Soil Surface
F. Gao, S.R. Yates, M.A. Anderson and M.V. Yates

Dynamism of Non-Equilibrium Complex Systems As
Fluid Flow In Soil
R.E. Ernst, S.E. Allaire-Leung and S.R. Yates

2-D Movement and Volatilization of Fumigants In Soils
Under Different Management Methods

8. **Appendix A**

Technology Transfer Accomplishments for 1999-2000

Laboratory Program

HISTORY

In May 1995, the George E. Brown Jr. Salinity Laboratory moved to a state-of-the-art facility on the campus of the University of California at Riverside. The laboratory, which was established in 1937, previously occupied 10 acres south of Mount Rubidoux in western Riverside.

The new building includes offices, constant temperature rooms, and 18 different laboratories. Four greenhouses and three environmental chambers are conveniently attached to the main building. A climate-controlled rhizotron, lysimeters and sand tank facilities are also located on USSL grounds, along with mechanical and electrical shops.

Sixteen permanent scientists as well as ten post-doctoral researchers and twenty technicians work under three research units: Soil-Water Chemistry and Assessment, Plant Science & Food Safety, and Soil Physics-Pesticides. Scientists from many foreign countries frequently visit the laboratory for education and technical exchange.

The laboratory works closely with USDA's National Resources Conservation Service (formerly the Soil Conservation Service) and the U.S. Bureau of Reclamation. Close cooperative relations are also maintained with the state agricultural centers around the world.

The George E. Brown Jr. Salinity Laboratory has served as a model for the establishment of Salinity Laboratories in India, Australia, Egypt, Israel, and Canada.

Irrigation is an ancient and yet important agricultural practice. Crop yields are higher under irrigation and less dependent on the effects of weather. While accounting for Only 15% of the world's cultivated land, irrigated soils produce 35-40% of the global food harvest; much more in semiarid and arid lands.

Unfortunately, irrigation often leads to the buildup of salts, toxic chemicals, and pesticides in associated soils and waters. Yield reductions related to salinity occur on an estimated 30% of irrigated land in the United States and 50% or more in some other nations. Approximately 10 million hectares (25 million acres) are permanently being lost each year from agriculture as a result of salinity and related problems.

The George E. Brown Jr. Salinity Laboratory is the nation's primary facility dedicated to basic research on salinity problems in agriculture. The laboratory is operated by the USDA Agricultural Research Service.